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Research Article

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Effect of mineral enriched compost on soil physical parameters

■ BRAJENDRA, K. SUREKHA, P. C. LATHA AND N. SAILAJA

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MEMBERS OF RESEARCH FORUM:

Corresponding author :
BRAJENDRA, ICAR-Indian Institute of Rice Research, HYDERABAD (TELANGANA) INDIA

Co-authors :
K. SUREKHA, P.C. LATHA AND N. SAILAJA, ICAR-Indian Institute of Rice Research, HYDERABAD (TELANGANA) INDIA

Summary

Two years field experiments were conducted at the Indian Institute of Rice Research Farm, Hyderabad, to compare the performance of field fortified poultry manure applications on physical dynamics of soil. Continuous application of MEC treatments resulted in decline in the pH of the soil in all the treatments from the initial levels of 8.07. Analysis of post harvest soils of MEC for physical parameters revealed that plots treated with inorganic fertilizer alone had an adverse effect on bulk density, porosity, water holding capacity, void ratio and available water after harvest of crop. The values of bulk density ranged from 1.2 to 1.35 g/cc with a mean value of 1.3g/cc. Similar trends were noticed in terms of water holding capacity and percentage porosity values. The lowest bulk density (1.17g/cc) was observed in case of control plots whereas maximum (1.35 g/cc) was observed in case of NPK treated plots.

Key words : Mineral enriched compost, Bulk density, Porosity, Water holding capacity

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Introduction

Higher yields can be obtained by using chemical fertilizers but indiscriminate use of it has adverse effect on the soil structure, environment and fauna. Now-a-days attention is being shifted towards alternate sources *i.e.*, organic manures for plant nutrition. Manures are the organic substances that are obtained from the decomposition of animal and plant wastes through the action of microbes. The organic manures that are in use are farm yard manure, compost of farm waste, crop residue, cattle dung, poultry manure, green manures, cakes, sewage sludge, municipal city compost, vermicompost etc. Manures are essential for crop growth, productivity and sustainability. Manure requirement and their soil applications to boost soil fertility and productivity of crops can be quite large and thus expensive. IIRR through an in house project has formulated a strategy of scaling down the use of fertilizer especially N, P with the use of poultry manure and vermi manure. Poultry manure obtained from PDP, Hyderabad was fortified with 10 per cent and 20 per cent of urea and SSP and the resulting product was formulated as a cost effective treatment for meeting the crop N and P requirement in rice. The field fortified product was labeled as enriched nitrogen and phosphorus poultry manure and was designed for field application to irrigated field conditions. Two years of field trial has proved that it is possible to obtain a productivity of 3-4t/ha of rice productivity with both hybrid and high yielding varieties with substantial improvement in soil quality parameters. The same plots were studied in great details about

changes in physical properties of soils with the continued two years of MEC application.

Resource and Research Methods

Two years field experiments were conducted at the Indian Institute of Rice Research Farm, Hyderabad, India on a deep black clayey vertisol (Typic Pellustert) to compare the performance of field fortified poultry manure applications on two rice varieties. The I.I.R.R. plot selected for the purpose was D-7 with a soil pH of 8.07; containing 1.24 per cent organic matter; available N at 191 kg ha^{-1}; available P at 25 kg ha^{-1} and available K at 389 kg ha^{-1}. Further more, available calcium and magnesium levels were high and available sulphur was low (8 kg ha^{-1}). Soil levels of the micronutrients Zn and Cu were high and Fe and Mn status was low.

The field experiment was made up of ten treatments that included different levels of field fortification of poultry as well as vermi manure with 10 and 20 per cent of total nitrogen and phosphorus requirement to be met with urea and superphosphate applications on two rice varieties - one the hybrid KRH2 and the other the high yielding variety Krishnahamsa. The experimental design was Randomized Block with three replicates of plot size 7.6 m^2 giving an overall total of 60 plots. A recommended dose of fertilizers (RDF) of total 120:80:60 (N: P: K) was taken as conventional treatment and one absolute control was maintained to observe the significant differences.

Every year soil samples were collected to analyze soil physical parameters as well as other soil parameters like chemical, physico-chemical etc. Present study included only soil physical parameters. Gravimetric methods were followed for bulk density and water holding capacity. Pycnometer method was used for particle density. Porosity was calculated indirectly by the universal well known formula. Excel software was used for data analysis.

Research Findings and Discussion

Through analytical data, it was observed that the plots treated by inorganic fertilizer alone showed adverse effect on bulk density, porosity, water holding capacity and available water after harvest of crop (Table 1). However, the plot treated organically or with combination of both organic as well as inorganic showed better result on the above physical parameters. Soil pH varied from 6.8 to 7.6 with a mean of 7.1. Soluble salts measured in terms of electrical conductivity ranged from 0.9 to 1.1. Higher values of salts concentration were recorded as poultry manure contains higher salts in its manorial composition. Highest bulk density value of 1.35g/cc was recorded. Different MEC treatments had a cascading effect on bulk density value. This is of particular relevance to the rice soils as submergence lead to a rapid rise in the value of bulk density. The values of bulk density ranged from 1.2 to 1.35 g/cc with a mean value of 1.3g/cc. Similar trends were noticed in terms of water holding

Table 1: Comparative study of effect of MEC treatments on soil physical paramaters

Treatments	Soil pH	EC (dS/m)	Bulk density (g/cc)	Porosity (%)	Water holding capacity (%)
T_1 Absolute control (Native fertility)	6.79	0.89	1.17	37.4	33.18
T_2 2T/ha vermi manure + 10%N (Nitro. compost)	7.15	0.95	1.21	42.2	40.75
T_3 2T/ha vermi manure +20%N (Nitro. compost)	7.22	0.88	1.25	49.7	39.30
T_4 2T/ha vermi manure + 10%P (Phospho. compost)	7.25	0.98	1.22	44.1	44.25
T_5 2T/ha vermi manure + 20%P (Phospho. compost)	6.85	0.89	1.33	41.3	36.25
T_6 2T/ha poultry manure + 10%N (Nitro. compost)	6.94	0.97	1.28	49.4	48.80
T_7 2T/ha poultry manure + 20%N (Nitro. compost)	7.15	0.98	1.24	44.6	45.16
T_8 2T/ha poultry manure + 10%P (Phospho. compost)	7.35	1.01	1.25	44.0	40.53
T_9 2T/ha poultry manure + 20%P (Phospho. compost)	7.56	1.11	1.22	48.8	47.21
T_{10} Recommended dose of fertilizer	7.02	0.98	1.35	39.2	39.89
Range	6.8-7.6	0.9-1.1	1.2-1.35	37.4- 9.7	33.2-48.8
Mean	7.1	1.0	1.3	44.0	41.4
STD	0.2	0.1	0.1	4.2	4.9
C.V. (%)	3.3	7.1	4.4	9.7	11.7

capacity and percentage porosity values (Table 1).The lowest bulk density (1.17g/cc) was observed in case of control plots whereas maximum (1.35 g/cc) was observed in case of NPK treated plots (Table 1). Available water was found highest in poultry manure treated plot (48.8%) as compared to control plot which was only 33.8 per cent. Similar trend was also observed in water holding capacity which is well depicted in the Table 1. Water holding capacity was increased in those plots which were treated with either sole FYM or in combinations of FYM with other fertilizer sources. However, the plots which were treated inorganically showed comparatively lower water holding capacity on long term basis.

Therefore, it is concluded that organic supplement to the soil results better soil physical health as compared to inorganic fertilizer. Higher value of bulk density might be a reason of decrease in crop yield.

Significant changes in bulk density take place when a rice soil is subjected to submergence (Armida *et al*., 2005). Quality work on rice soil was also studied by Vos *et al*. (2005) to examine the changes on bulk density. Osunbitan *et al*. (2005) studied on tillage effects on bulk density, hydraulic conductivity and strength of a loamy sand soil in southwestern Nigeria. Carter (2005) worked for long-term tillage effects for fine sandy loams in the humid climate of Atlantic Canada and found significant changes in bulk density. Mouazen *et al.* (2003) predicted dry bulk density as a function of moisture content, depth and draught which was derived from the regression equation.

Ares *et al*. (2005) worked on the topic of ground-based forest harvesting effects on soil physical properties. Guswa (2005) worked for soil-moisture and plant uptake relationship. Li *et al*. (2005) established the relationship for optimization of irrigation scheduling for winter wheat in the North China Plain. Dolling *et al*. (2005) worked on water use and lucern growth in different types of soil. Dolling *et al*. (2005) expressed his research view on soil water extraction in the south Western Australia as influenced by lucern biomass production.

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